奇美電子
CHIMEI INNOLUX

PRODUCT SPECIFICATION

☐ Tentative Specification
☐ Preliminary Specification
■ Approval Specification

MODEL NO.: V460H1
SUFFIX: LE3

REV.: C3 (upward)

Customer:

APPROVED BY **SIGNATURE**

Name / Title _____ _____

Note

Please return 1 copy for your confirmation with your signature and comments.

Approved By	Checked By	Prepared By
Chao-Chun Chung	Ken Wu	HT Hung

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver. 1.0	Feb. 12.'10	All	All	The Preliminary Specification was first issued.
Ver. 2.0	Mar. 24.'10	All	All	The Approval Specification was first issued.
Ver. 2.1	Mar. 30' 10	6	1.5	Update MECHANICAL SPECIFICATIONS
Ver. 2.2	Jun. 15' 10	5 29	1.2 7.2	Modify High contrast ratio (6000:1) Modify OPTICAL SPECIFICATIONS
Ver. 2.3	Aug. 19' 10	6 22 29 36	1.5 5.4 7.2 11	Modify MECHANICAL SPECIFICATIONS Modify LVDS INTERFACE Modify OPTICAL SPECIFICATIONS Modify MECHANICAL CHARACTERISTICS
Ver. 2.4	Oct. 18' 10	12 12 34 36	3.2.1 3.2.2 10.2 11	Modify 3.2.1 LED CHARACTERISTICS Modify 3.2.2 CONVERTER CHARACTERISTICS Modify Figures 10-1 and 10-2 are the packing method Modify MECHANICAL CHARACTERISTICS
Ver. 2.5	Jan. 19' 11	18	5.1	Modify 5.1 Note (2)

1. GENERAL DESCRIPTION

1.1 OVERVIEW

V460H1-LE3 is a 46" TFT Liquid Crystal Display module with LED Backlight and 4ch-LVDS interface. This module supports 1920 x 1080 Full HDTV format and can display true 1.07G colors (8bit+Hi-FRC -bit/color). The converter module for backlight is built-in.

1.2 FEATURES

- High brightness (450 nits)
- High contrast ratio (6000:1)
- Fast response time (Gray to gray average 5.5 ms)
- High color saturation (NTSC 72%)
- Full HDTV (1920 x 1080 pixels) resolution, true HDTV format
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- Optimized response time for 120 Hz frame rate
- Ultra wide viewing angle : Super MVA technology
- RoHS compliance

1.3 APPLICATION

- Standard Living Room TVs.
- Public Display Application.
- Home Theater Application.
- MFM Application.

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	1018.08 (H) x 572.67 (V) (46" diagonal)	mm	(1)
Bezel Opening Area	1024.48 (H) x 578.67 (V)	mm	
Driver Element	a-si TFT active matrix	-	
Pixel Number	1920 x R.G.B. x 1080	pixel	
Pixel Pitch (Sub Pixel)	0.1805 (H) x 0.5405 (V)	mm	
Pixel Arrangement	RGB vertical stripe	-	
Display Colors	1.07G	color	
Display Operation Mode	Transmissive mode / Normally Black	-	
Surface Treatment	Anti-Glare Coating (Haze 11%) Hard Coating (3H)	-	(2)

Note (1) Please refer to the attached drawings in chapter 9 for more information about the front and back outlines.

Note (2) The spec. of the surface treatment is temporarily for this phase. CMO reserves the rights to change this feature.

1.5 MECHANICAL SPECIFICATION

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	1075.5	1076.5	1077.5	mm	(1)
	Vertical(V)	633.7	634.7	635.7	mm	
	Depth(D)	11.6	12.6	13.6	mm	To Rear (Side)
	Depth(D)	11.6	12.6	15.6	mm	To Rear (Middle)
	Depth(D)	24.6	25.6	28.6	mm	To converter cover
Weight		-	9500	-	g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol		Value		Unit	Note
			Min.	Max.		
Storage Temperature	TST		-20	+60	ºC	(1)
Operating Ambient Temperature	TOP		0	50	ºC	(1), (2)
Shock (Non-Operating)	SNOP	X,Y axis	-	35	G	(3), (5)
		Z axis		35	G	(3), (5)
Vibration (Non-Operating)	VNOP		-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

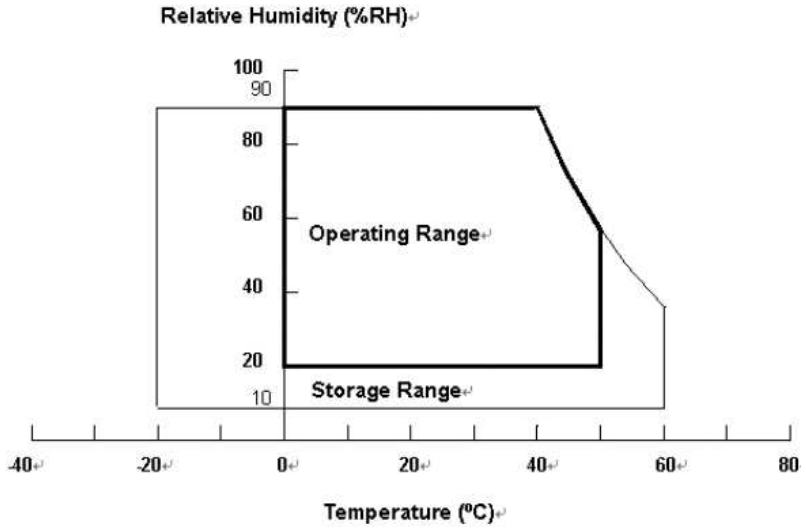
(c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 ºC with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 ºC. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



2.2 PACKAGE STORAGE

When storing modules as spares for a long time, the following precaution is necessary.

(a) Do not leave the module in high temperature, and high humidity for a long time, It is highly recommended to store the module with temperature from 0 to 35 ℃ at normal humidity without condensation.

(b) The module shall be stroed in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

2.3 ELECTRICAL ABSOLUTE RATINGS

2.3.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	13.5	V	(1)
Logic Input Voltage	VIN	-0.3	3.6	V	

2.3.2 BACKLIGHT CONVERTER UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Light Bar Voltage	VW	–	60	V	
Converter Input Voltage	VBL	0	30	V	(1)
Control Signal Level	–	-0.3	7	V	(1), (3)

Note (1) Permanent damage to the device may occur if maximum value s are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) No moisture condensation or freezing.

Note (3) The control signals include On/Off Contro.l Internal PWM Control and External PWM Control.

3. ELECTRICAL CHARACTERISTICS

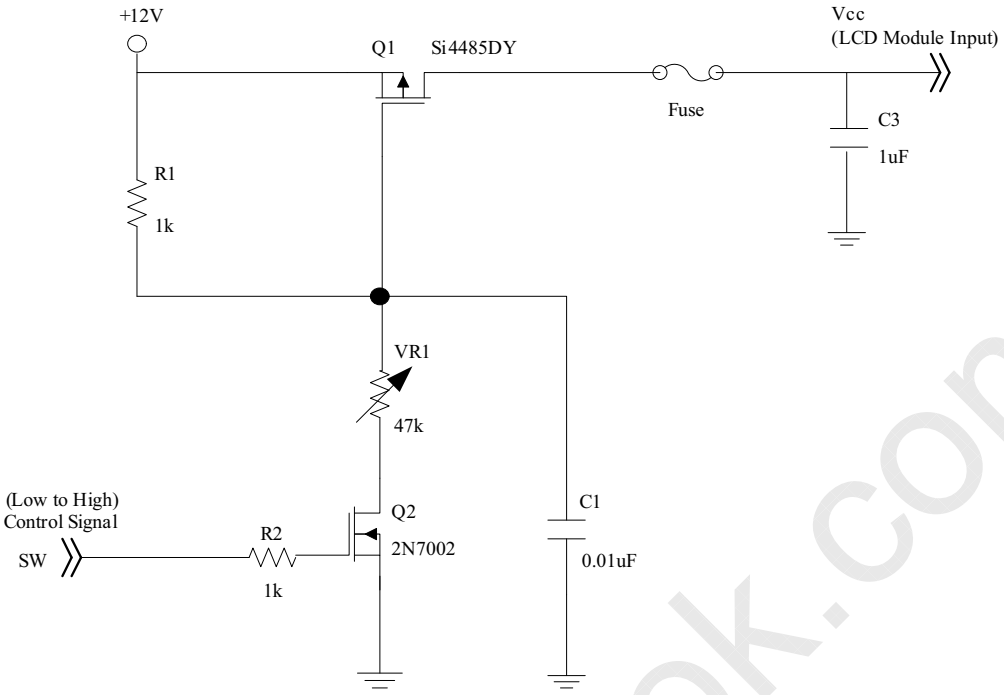
3.1 TFT LCD MODULE

(Ta = 25 ± 2 ºC)

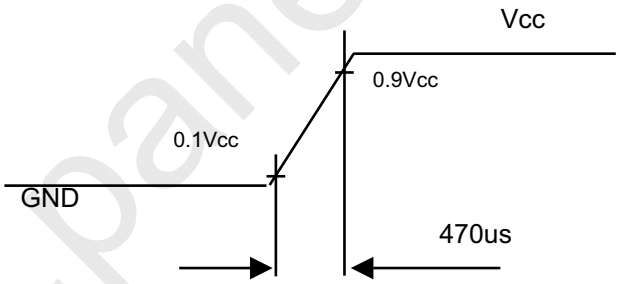
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(1)
Rush Current		I_{RUSH}	-	-	4	A	(2)
Power Supply Current	White Pattern	-	-	0.5	0.65	A	(3)
	Horizontal Stripe	-	-	0.94	1.22	A	
	Black Pattern	-	-	0.42	0.54	A	
LVDS interface	Differential Input High Threshold Voltage	V_{LVTH}	+100	-	-	mV	(4)
	Differential Input Low Threshold Voltage	V_{LVTL}	-	-	-100	mV	
	Common Input Voltage	V_{CM}	1.0	1.2	1.4	V	
	Differential input voltage (Single-end)	$\|V_{ID}\|$	200	-	600	mV	
	Terminating Resistor	R_T	-	100	-	ohm	
CMOS interface	Input High Threshold Voltage	V_{IH}	2.7	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0	-	0.7	V	

Note (1) The module should be always operated within the above ranges.

Note (2) Measurement condition:



Vcc rising time is 470us



Note (3) The specified power supply current is under the conditions at Vcc = 12 V, Ta = 25 ± 2 ºC, f_v = 120 Hz, whereas a power dissipation check pattern below is displayed.

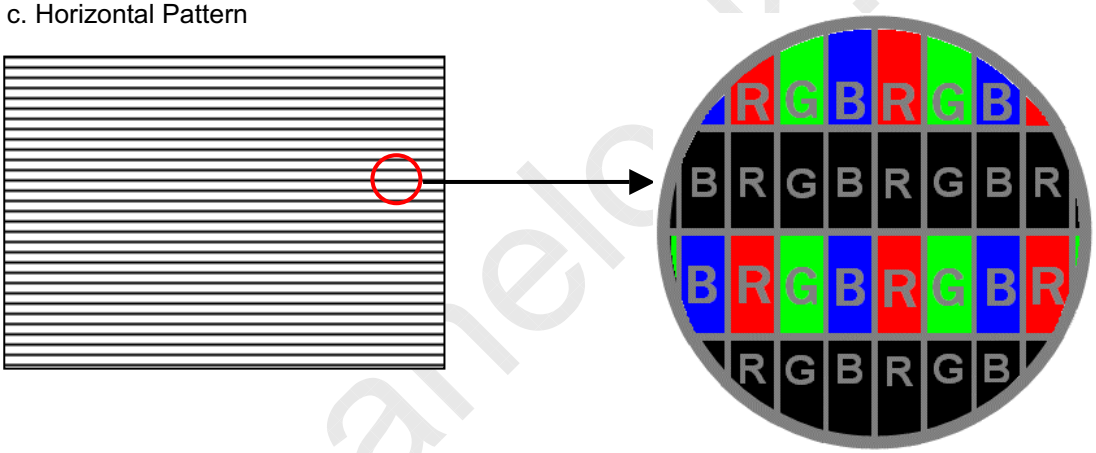
a. White Pattern

Active Area

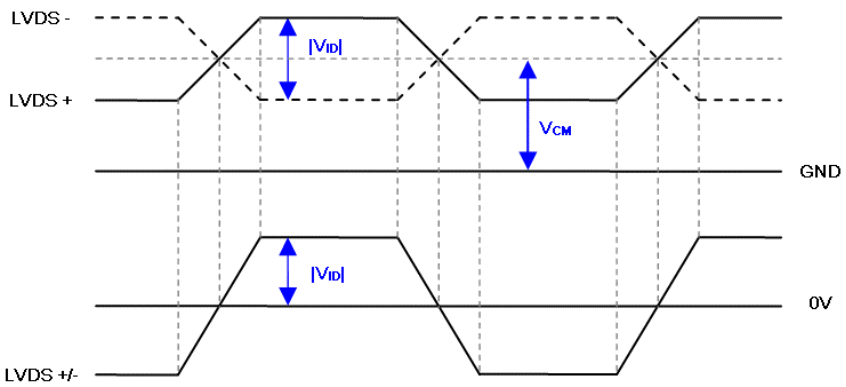
b. Black Pattern

Active Area

c. Horizontal Pattern



Note (4) The LVDS input characteristics are as follows:



3.2 BACKLIGHT UNIT

3.2.1 LED CHARACTERISTICS (Ta=25± 2 ºC)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Light Bar Voltage	V_W	-	-	45.5	V_{RMS}	I_L =120mA
Forward Voltage	V_f	3.0	3.2	3.5	V_{RMS}	I_L =120mA
LED Current	I_L	112.8	120	127.2	mA_{RMS}	
Life time	-	30,000	-	-	Hrs	(1)

Note (1) The lifetime is defined as the time which luminance of the LED decays to 50% compared to the initial value, Operating condition: Continuous operating at Ta = 25±2℃, I_L =120mA.

3.2.2 CONVERTER CHARACTERISTICS (Ta = 25 ± 2 ºC)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Consumption	P_{BL}	-	108	118.8	W	(1),(2) IL = 120 mA
Converter Input Voltage	V_{BL}	22.8	24	25.2	V_{DC}	
Converter Input Current	I_{BL}	-	4.5	4.95	A	Non Dimming
Input Rush current	-	-	-	7	A	(3)
Dimming Frequency	F_B	150	160	170	Hz	
Minimum Duty Ratio	D_{MIN}	5	10	-	%	(4)

Note (1) The power supply capacity should be higher than the total converter power consumption P_{BL}. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when converter dimming.

Note (2) The measurement condition of Max. value is based on 46" backlight unit under input voltage 24V, average LED current 120 mA and lighting 1 hour later.

Note (3) The duration of Input Rush Current is about 30ms.

Note (4) 5% minimum duty ratio is only valid for electrical operation.

3.2.3 CONVERTER INTERFACE CHARACTERISTICS

Parameter		Symbol	Test Condition	Value			Unit	Note
				Min.	Typ.	Max.		
On/Off Control Voltage	ON	VBLON	—	2.0	—	5.0	V	
	OFF		—	0	—	0.8	V	
Internal PWM Control Voltage	MAX	VIPWM	—	2.85	3.0	3.15	V	maximum duty ratio
	MIN		—	—	0	—	V	minimum duty ratio
External PWM Control Voltage	HI	VEPWM	—	2.0	—	5.0	V	Duty on
	LO		—	0	—	0.8	V	Duty off

Status Signal	HI	Status	–	3.0	3.3	3.6	V	Normal
	LO		–	0	–	0.8	V	Abnormal
VBL Rising Time		Tr1	–	30	–	–	ms	10%-90%V_{BL}
Control Signal Rising Time		Tr	–	–	–	100	ms	
Control Signal Falling Time		Tf	–	–	–	100	ms	
PWM Signal Rising Time		TPWMR	–	–	–	50	us	
PWM Signal Falling Time		TPWMF	–	–	–	50	us	
Input Impedance		Rin	–	1	–	–	MΩ	
PWM Delay Time		TPWM	–	100	–	–	ms	
BLON Delay Time		T_{on}	–	300	–	–	ms	
		T_{on1}	–	300	–	–	ms	
BLON Off Time		Toff	–	300	–	–	ms	

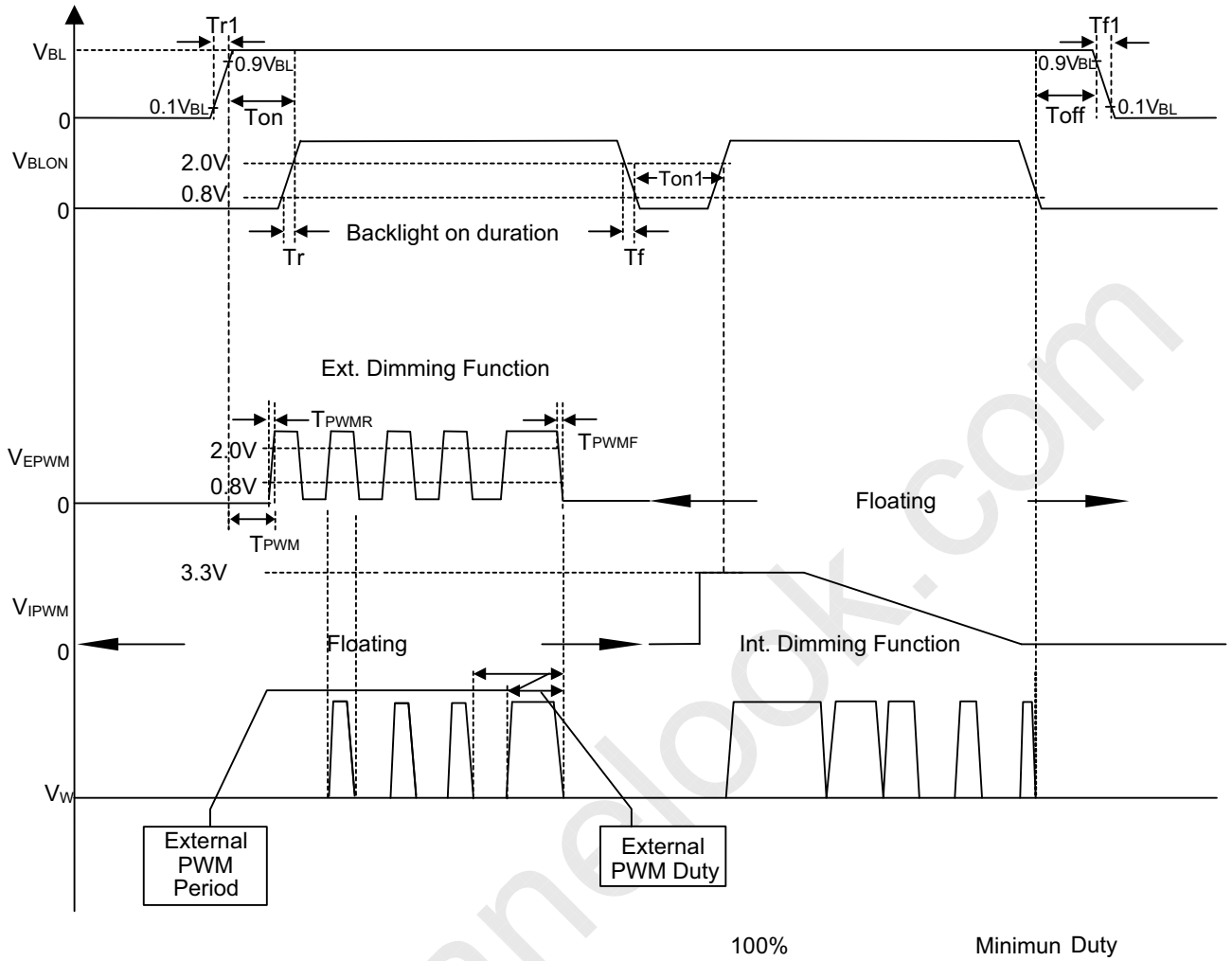
Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the following figure. For a certain reason, the inverter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

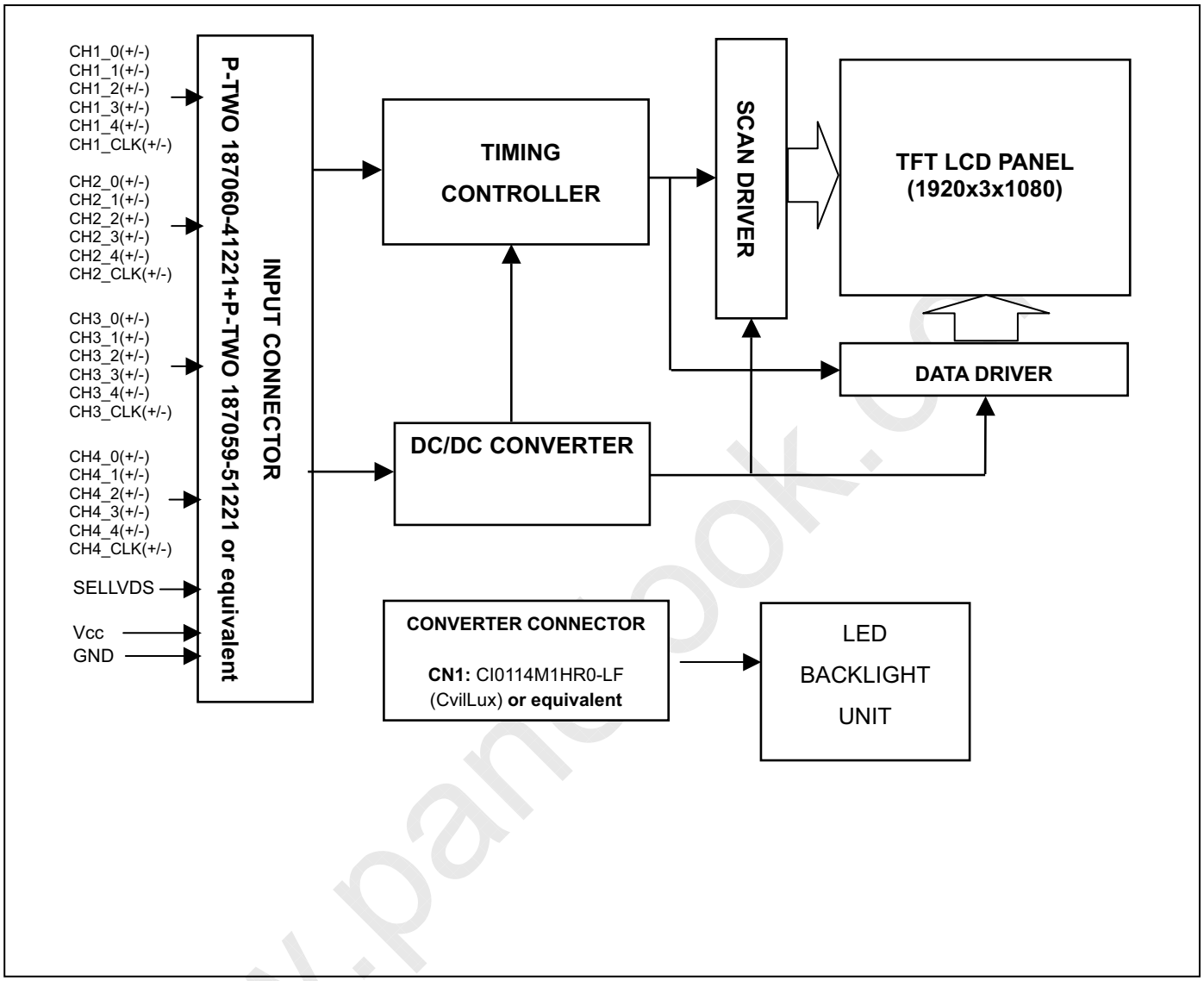
Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL



4. BLOCK DIAGRAM OF INTERFACE

4.1 TFT LCD MODULE



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD Module Input

CNF3 Connector Pin Assignment (187060-41221(P-TWO) or equivalent)

Pin	Name	Description	Note
1	GND	Ground	
2	N.C.	No Connection	(1)
3	N.C.	No Connection	
4	N.C.	No Connection	
5	N.C.	No Connection	
6	N.C.	No Connection	
7	N.C.	No Connection	
8	N.C.	No Connection	
9	GND	Ground	
10	CH3_0N	Third Pixel Negative LVDS differential data input. Channel 0	(4)
11	CH3_0P	Third Pixel Positive LVDS differential data input. Channel 0	
12	CH3_1N	Third Pixel Negative LVDS differential data input. Channel 1	
13	CH3_1P	Third Pixel Positive LVDS differential data input. Channel 1	
14	CH3_2N	Third Pixel Negative LVDS differential data input. Channel 2	
15	CH3_2P	Third Pixel Positive LVDS differential data input. Channel 2	
16	GND	Ground	
17	CH3_CLKN	Third Pixel Negative LVDS differential clock input.	
18	CH3_CLKP	Third Pixel Positive LVDS differential clock input.	
19	GND	Ground	
20	CH3_3N	Third Pixel Negative LVDS differential data input. Channel 3	(4)
21	CH3_3P	Third Pixel Positive LVDS differential data input. Channel 3	
22	CH3_4N	Third Pixel Negative LVDS differential data input. Channel 4	
23	CH3_4P	Third Pixel Positive LVDS differential data input. Channel 4	
24	N.C.	No Connection	(1)
25	N.C.	No Connection	
26	CH4_0N	Fourth Pixel Negative LVDS differential data input. Channel 0	(4)
27	CH4_0P	Fourth Pixel Positive LVDS differential data input. Channel 0	
28	CH4_1N	Fourth Pixel Negative LVDS differential data input. Channel 1	
29	CH4_1P	Fourth Pixel Positive LVDS differential data input. Channel 1	
30	CH4_2N	Fourth Pixel Negative LVDS differential data input. Channel 2	
31	CH4_2P	Fourth Pixel Positive LVDS differential data input. Channel 2	
32	GND	Ground	
33	CH4_CLKN	Fourth Pixel Negative LVDS differential clock input.	
34	CH4_CLKP	Fourth Pixel Positive LVDS differential clock input.	
35	GND	Ground	(4)
36	CH4_3N	Fourth Pixel Negative LVDS differential data input. Channel 3	
37	CH4_3P	Fourth Pixel Positive LVDS differential data input. Channel 3	
38	CH4_4N	Fourth Pixel Negative LVDS differential data input. Channel 4	
39	CH4_4P	Fourth Pixel Positive LVDS differential data input. Channel 4	
40	N.C.	No Connection	(1)
41	N.C.	No Connection	

CNF2 Connector Pin Assignment (187059-51221 (P-TWO) or equivalent)

Pin	Name	Description	Note
1	N.C.	No Connection	(1)
2	N.C.	No Connection	
3	N.C.	No Connection	
4	N.C.	No Connection	
5	N.C.	No Connection	
6	N.C.	No Connection	
7	SELLVDS	LVDS data format Selection	(2)
8	N.C.	No Connection	(1)
9	N.C.	No Connection	
10	N.C.	No Connection	
11	GND	Ground	
12	CH1_0N	First Pixel Negative LVDS differential data input. Channel 0	(3)
13	CH1_0P	First Pixel Positive LVDS differential data input. Channel 0	
14	CH1_1N	First Pixel Negative LVDS differential data input. Channel 1	
15	CH1_1P	First Pixel Positive LVDS differential data input. Channel 1	
16	CH1_2N	First Pixel Negative LVDS differential data input. Channel 2	
17	CH1_2P	First Pixel Positive LVDS differential data input. Channel 2	
18	GND	Ground	
19	CH1_CLKN	First Pixel Negative LVDS differential clock input.	
20	CH1_CLKP	First Pixel Positive LVDS differential clock input.	
21	GND	Ground	
22	CH1_3N	First Pixel Negative LVDS differential data input. Channel 3	(3)
23	CH1_3P	First Pixel Positive LVDS differential data input. Channel 3	
24	CH1_4N	First Pixel Negative LVDS differential data input. Channel 4	
25	CH1_4P	First Pixel Positive LVDS differential data input. Channel 4	
26	N.C.	No Connection	(1)
27	N.C.	No Connection	
28	CH2_0N	Second Pixel Negative LVDS differential data input. Channel 0	(3)
29	CH2_0P	Second Pixel Positive LVDS differential data input. Channel 0	
30	CH2_1N	Second Pixel Negative LVDS differential data input. Channel 1	
31	CH2_1P	Second Pixel Positive LVDS differential data input. Channel 1	
32	CH2_2N	Second Pixel Negative LVDS differential data input. Channel 2	
33	CH2_2P	Second Pixel Positive LVDS differential data input. Channel 2	
34	GND	Ground	
35	CH2_CLKN	Second Pixel Negative LVDS differential clock input.	
36	CH2_CLKP	Second Pixel Positive LVDS differential clock input.	
37	GND	Ground	
38	CH2_3N	Second Pixel Negative LVDS differential data input. Channel 3	(3)
39	CH2_3P	Second Pixel Positive LVDS differential data input. Channel 3	
40	CH2_4N	Second Pixel Negative LVDS differential data input. Channel 4	
41	CH2_4P	Second Pixel Positive LVDS differential data input. Channel 4	
42	N.C.	No Connection	(1)
43	N.C.	No Connection	
44	GND	Ground	

45	GND	Ground	
46	GND	Ground	
47	N.C.	No Connection	
48	Vin	Power input (+12V)	
49	Vin	Power input (+12V)	
50	Vin	Power input (+12V)	
51	Vin	Power input (+12V)	

Note (1) Please be reserved to open.

Note (2) Low: JEIDA Format (default), connect to GND. High and Open: VESA Format, connect to +3.3V.

Note (3) LVDS 4-Port Data Mapping

Port	CH of LVDS	Data Stream
1st Port	First pixel	1, 5, 9, ..., 1913, 1917
2nd Port	Second pixel	2, 6, 10, ..., 1914, 1918
3rd Port	Third pixel	3, 7, 11, ..., 1915, 1919
4th Port	Fourth pixel	4, 8, 12, ..., 1916, 1920

5.2 CONVERTER UNIT

CN1: CI0114M1HR0-LF (CvilLux) or equivalent

Pin №	Symbol	Feature
1	VBL	+24V
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	STATUS	Normal (3.3V) Abnormal(GND)
12	E_PWM	External PWM Control Signal
13	I_PWM	Internal PWM Control Signal
14	BLON	BL ON/OFF

Note (1) Pin 12: External PWM control (use pin 12): Pin 13 must open.

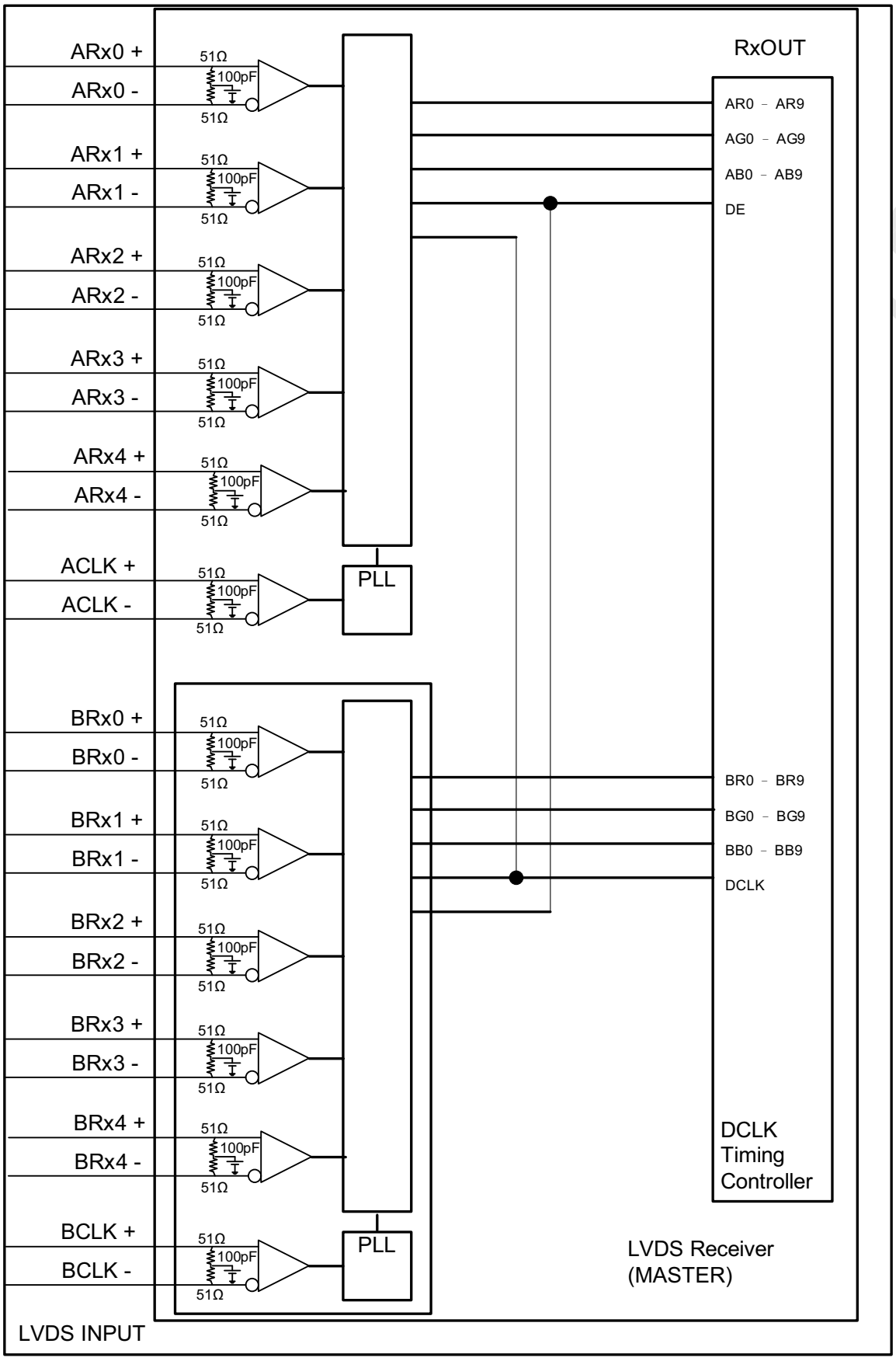
Note (2) Pin 13: Internal PWM control (use pin 13): Pin 12 must open.

Note (3) Pin 12 and Pin 13 can't open in the same period.

CN2~CN5: 51281-1094 (Molex) ,187059-51221 (P-TWO),7083K-F10N-00L (E&T)

Pin №	Symbol	Feature	NOTE
1	VLED	Positive of LED String	
2	VLED		
3	NC	No Connection	
4	NC		
5	NC		
6	N1	Negative of LED String	
7	N2		
8	N3		
9	N4		
10	N5		

5.3 BLOCK DIAGRAM OF INTERFACE



AR0~AR9: First pixel R data

AG0~AG9: First pixel G data

AB0~AB9: First pixel B data

BR0~BR9: Second pixel R data

BG0~BG9: Second pixel G data

BB0~BB9: Second pixel B data

DE: Data enable signal

DCLK: Data clock signal

The third and fourth pixel are followed the same rules.

CR0~CR9: Third pixel R data

CG0~CG9: Third pixel G data

CB0~CB9: Third pixel B data

DR0~DR9: Fourth pixel R data

DG0~DG9: Fourth pixel G data

DB0~DB9: Fourth pixel B data

Note (1) A ~ D channel are first, second, third and fourth pixel respectively.

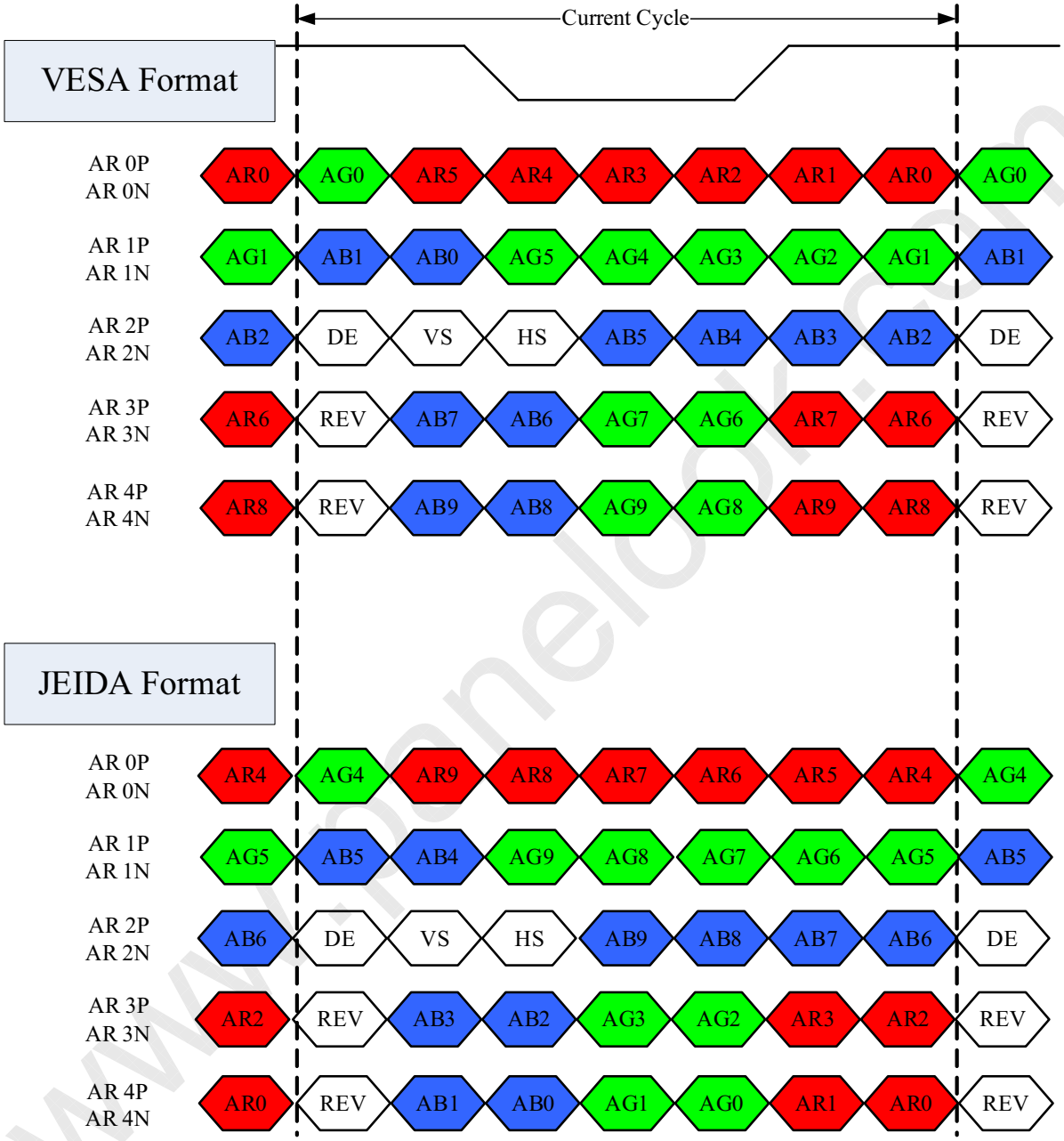
Note (2) The system must have the transmitter to drive the module.

Note (3) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

5.4 LVDS INTERFACE

JEIDA Format : SELLVDS = L or Open

VESA Format : SELLVDS = H



AR0~AR9: First Pixel R Data (9; MSB, 0; LSB)

AG0~AG9: First Pixel G Data (9; MSB, 0; LSB)

AB0~AB9: First Pixel B Data (9; MSB, 0; LSB)

DE : Data enable signal

DCLK : Data clock signal

RSVD : Reserved

5.5 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the (8bit+Hi-FRC -bit/color) gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

Color		Data Signal																													
		Red										Green										Blue									
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:			:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:			:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (1021)	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (1021)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
	Green (1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (1021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1
	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

(Ta = 25 ± 2 °C)

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	F_{clkin} (=1/TC)	60	74.25	80	MHz	
	Input cycle to cycle jitter	T_{rcl}	-	-	200	ps	(3)
	Spread spectrum modulation range	F_{clkin_mod}	F_{clkin}-2%	-	F_{clkin}+2%	MHz	(4)
	Spread spectrum modulation frequency	F_{SSM}	-	-	200	KHz	
LVDS Receiver Data	Setup Time	Tlvsu	600	-	-	ps	(5)
	Hold Time	Tlvhd	600	-	-	ps	
Vertical Active Display Term	Frame Rate	F_{r5}	97	100	103	Hz	(6)
		F_{r6}	117	120	123	Hz	
	Total	Tv	1115	1125	1135	Th	Tv=Tvd+Tvb
	Display	Tvd	1080	1080	1080	Th	—
	Blank	Tvb	35	45	55	Th	—
Horizontal Active Display Term	Total	Th	540	550	575	Tc	Th=Thd+Thb
	Display	Thd	480	480	480	Tc	—
	Blank	Thb	60	70	95	Tc	—

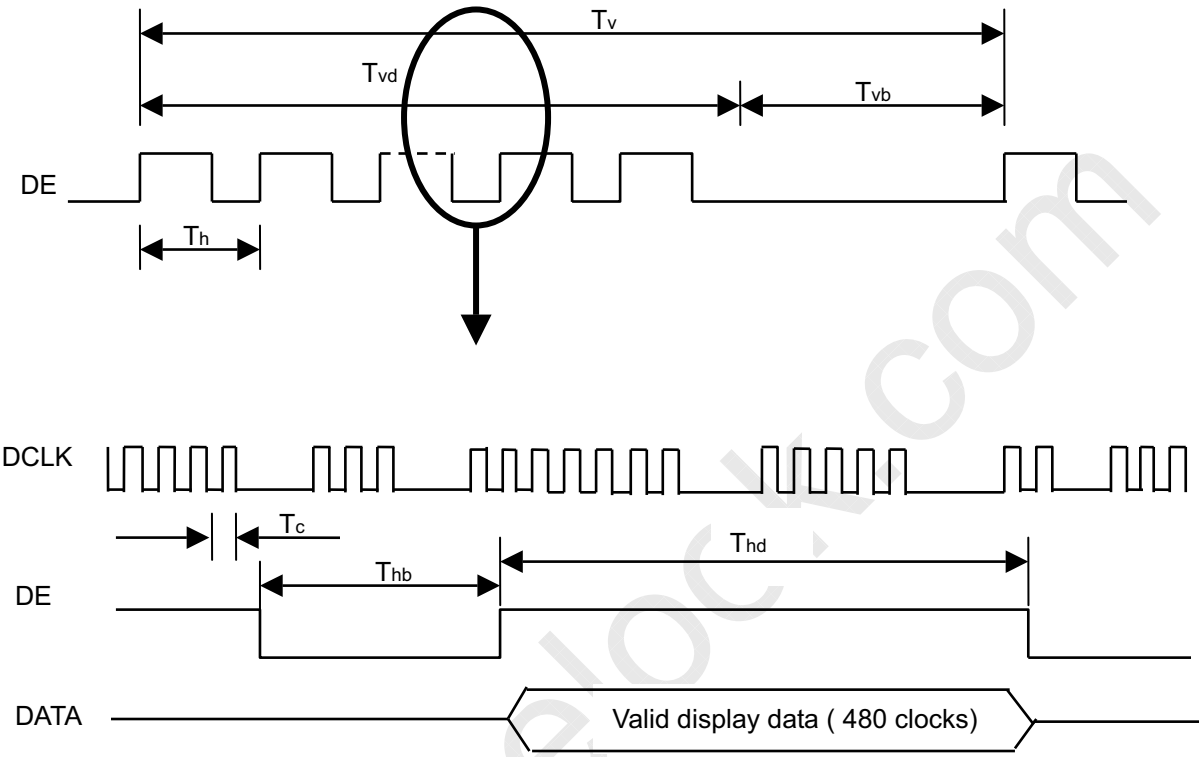
Note (1) Since the module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

Note (2) Please make sure the range of pixel clock has follow the below equation:

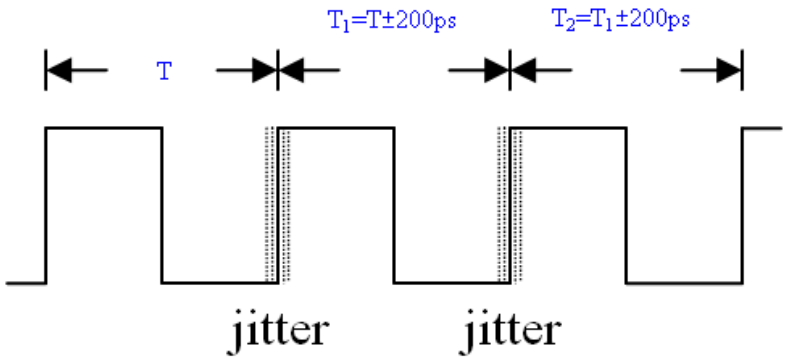
$F_{clkin(max)} \geqq F_{r6} \times Tv \times Th$

$F_{r5} \times Tv \times Th \geqq F_{clkin(min)}$

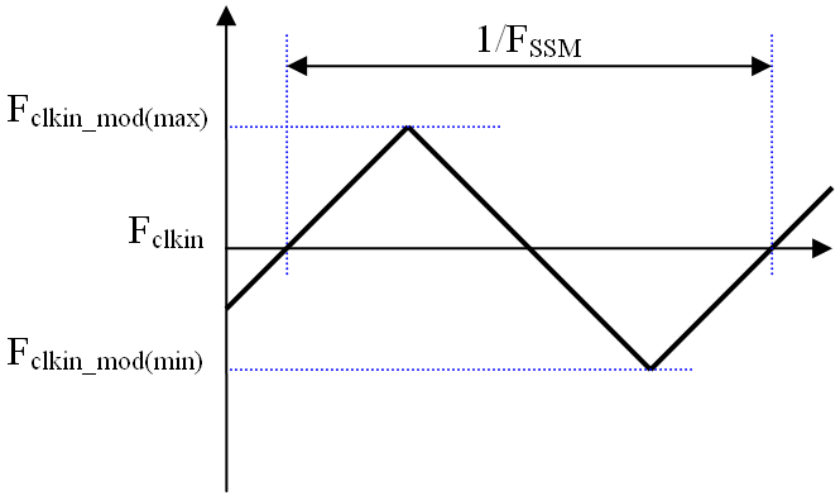
INPUT SIGNAL TIMING DIAGRAM



Note (3) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = l T_1 – Tl

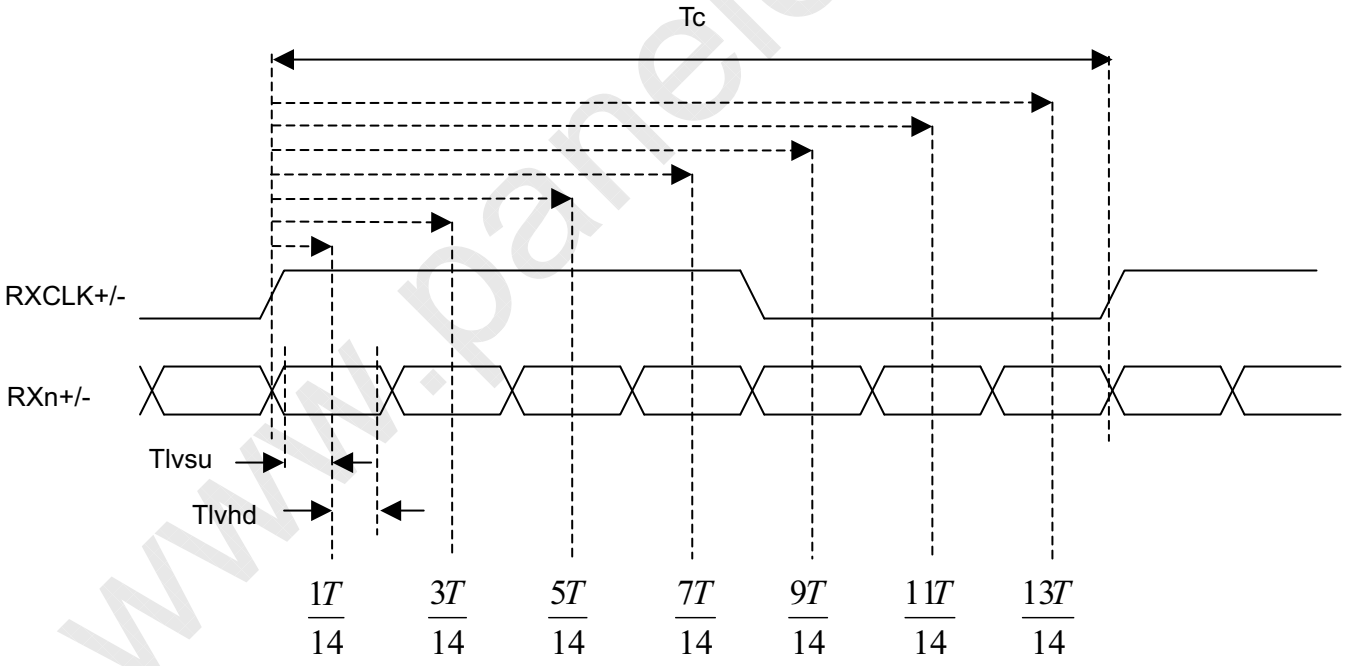


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

LVDS RECEIVER INTERFACE TIMING DIAGRAM

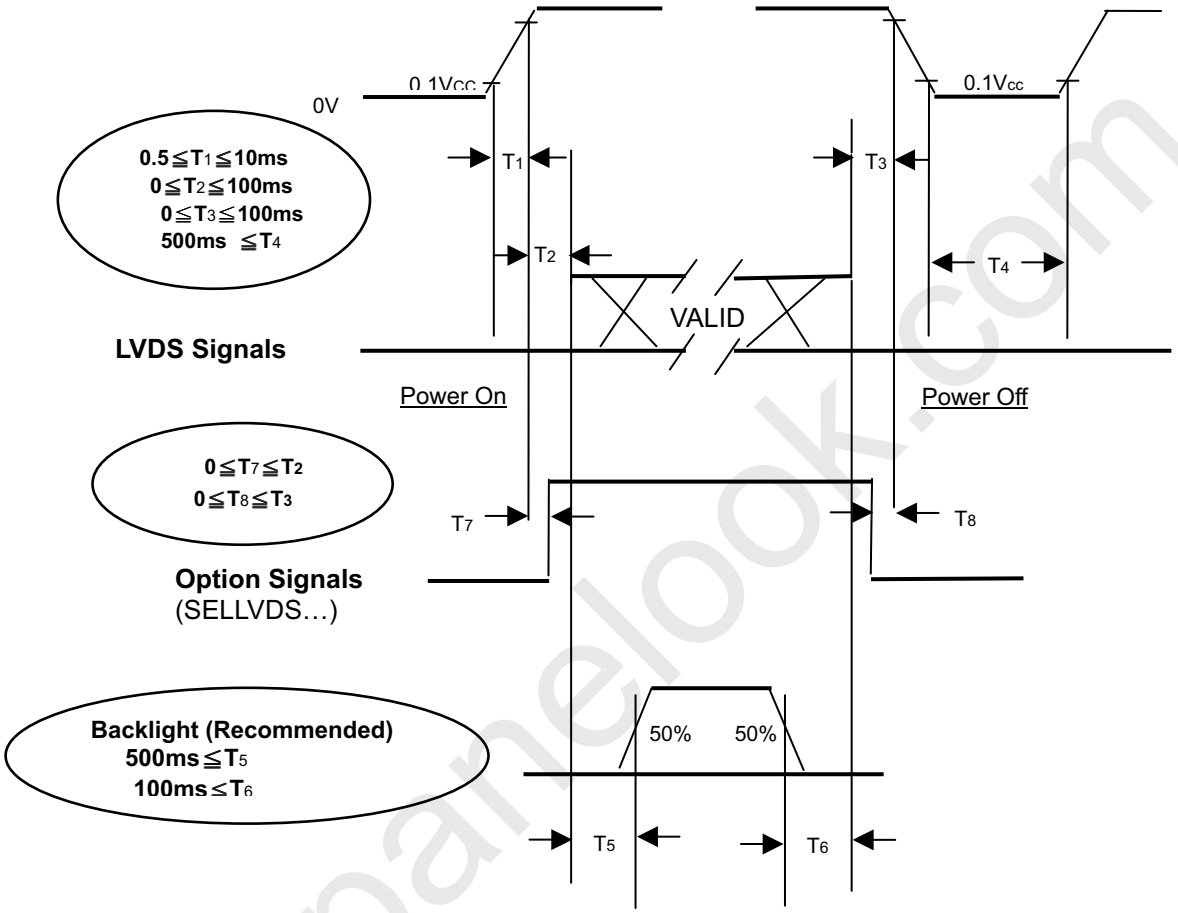


Note (6) : (ODSEL) = H/L or open for 100/120Hz frame rate. Please refer to 5.1 for detail information

6.2 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 ºC)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should follow the diagram below.



Power ON/OFF Sequence

Note.

(1) The supply voltage of the external system for the module input should follow the definition of Vcc.

(2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

(3) In case of VCC is in off level, please keep the level of input signals on the low or high impedance. If T2<0, that maybe cause electrical overstress failures.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

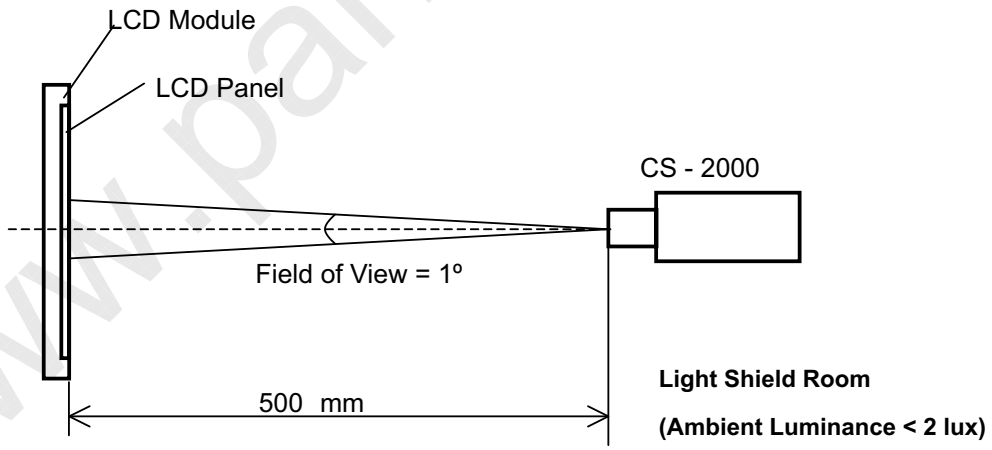
(5) Interface signal shall not be kept at high impedance when the power is on.

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	VCC	12	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Current	IL	120 ±3.6	mA
Vertical Frame Rate	Fr	120	Hz

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.



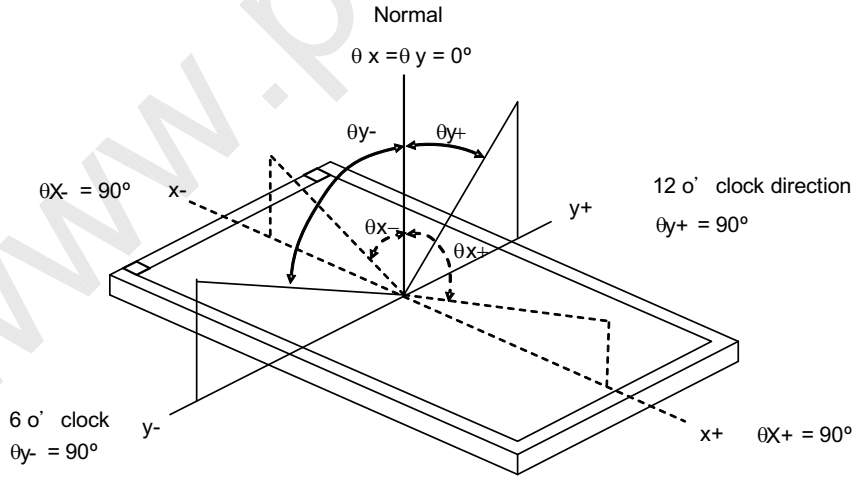
7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing angle at normal direction	4500	6000	-	-	Note (2)
Response Time		Gray to gray		-	5.5		ms	Note (3)
Center Luminance of White		L_C		360	450	-	cd/m^2	Note (4)
White Variation		δW		-	-	1.3	-	Note (6)
Cross Talk		CT		-	-	4	%	Note (5)
Color Chromaticity	Red	Rx		Typ.-0.03	0.642	Typ.+0.03	-	
		Ry			0.324		-	
	Green	Gx			0.303		-	
		Gy			0.621		-	
	Blue	Bx			0.147		-	
		By			0.068		-	
	White	Wx			0.280		-	
		Wy			0.290		-	
	Color Gamut				72	-	%	NTSC
Viewing Angle	Horizontal	θ_x+	CR≥20	80	88	-	Deg.	Note (1)
		θ_x-		80	88	-		
	Vertical	θ_Y+		80	88	-		
		θ_Y-		80	88	-		

Note (1) Definition of Viewing Angle (θx, θy):

Viewing angles are measured by Autronic Conoscope Cono-80.



Note (2) Definition of Contrast Ratio (CR):

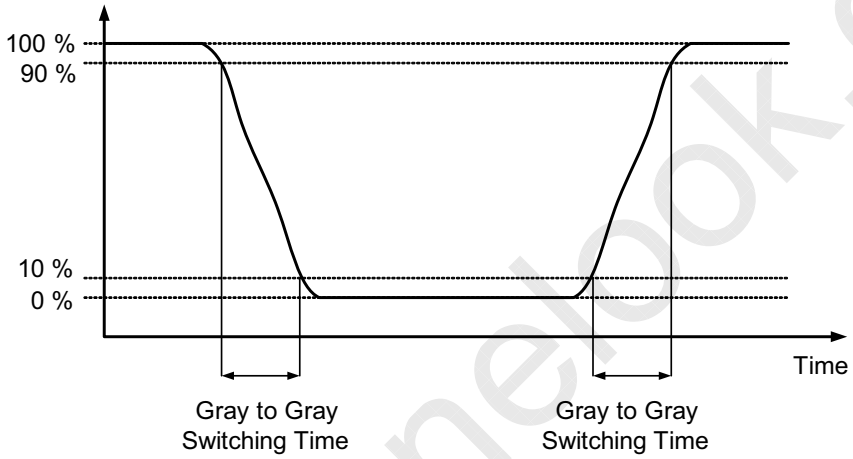
The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

Note (3) Definition of Gray-to-Gray Switching Time:

Optical Response



The driving signal means the signal of gray level 0, 124, 252, 380, 508, 636, 764, 892, and 1023.Gray to gray. Average time means the average switching time of gray level 0, 124, 252, 380, 508, 636, 764, 892, and 1023 to each other.

Note (4) Definition of Luminance of White (LC):

Measure the luminance of gray level 1023 at center point and 5 points

LC = L (5), where L (X) is corresponding to the luminance of the point X at the figure in Note (6).

Note (5) Definition of Cross Talk (CT):

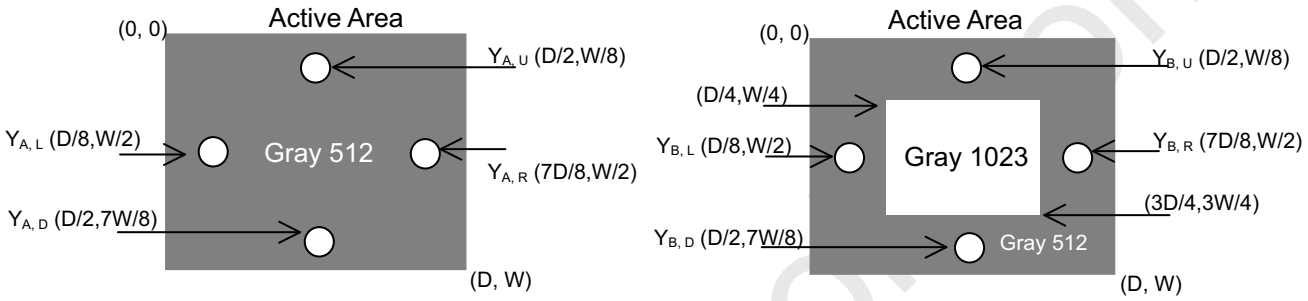
$CT = | Y_B - Y_A | / Y_A \times 100\ (\%)$

Where:

(a)

Y_A = Luminance of measured location without gray level 1023 pattern (cd/m^2)

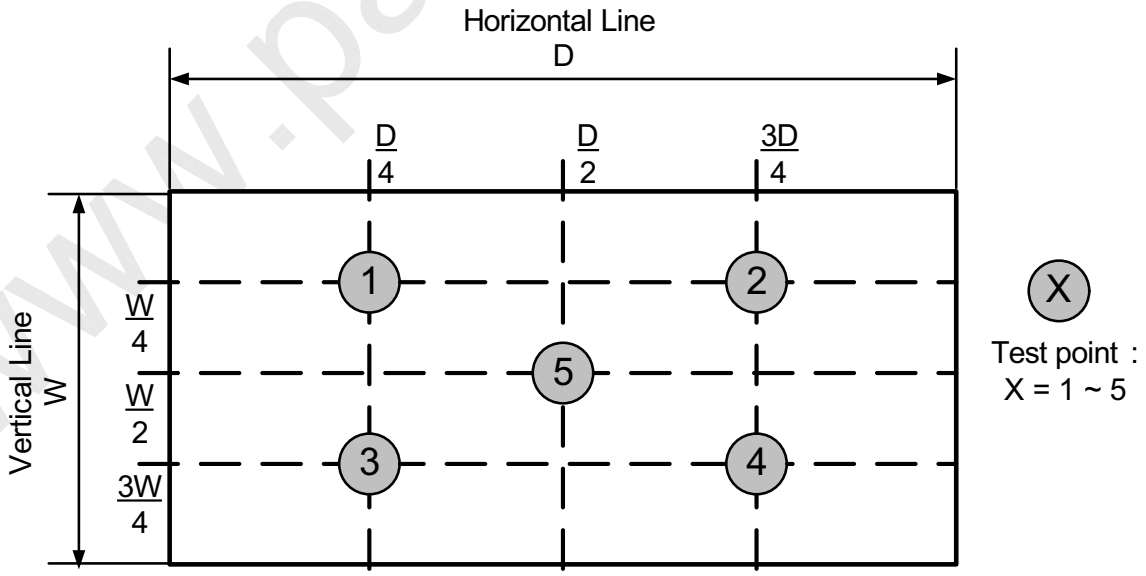
Y_B = Luminance of measured location with gray level 1023 pattern (cd/m^2)



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 1023 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

[1] Do not apply rough force such as bending or twisting to the module during assembly.

[2] It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

[3] Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.

[4] Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.

[5] Do not plug in or pull out the I/F connector while the module is in operation.

[6] Do not disassemble the module.

[7] Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

[8] Moisture can easily penetrate into LCD module and may cause the damage during operation.

[9] When storing modules as spares for a long time, the following precaution is necessary.

[9.1] Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃at normal humidity without condensation.

[9.2] The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

[10] When ambient temperature is lower than 10ºC, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

8.2 SAFETY PRECAUTIONS

[1] The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the Backlight unit.

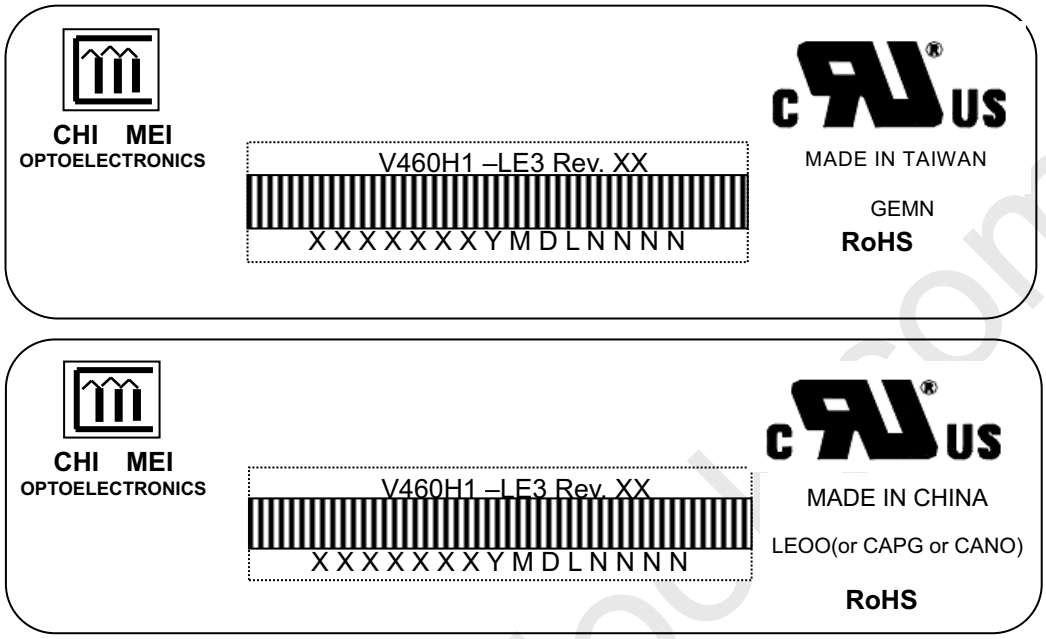
[2] If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

[3] After the module's end of life, it is not harmful in case of normal operation and storage.

9. DEFINITION OF LABELS

9.1 CMO MODULE LABEL

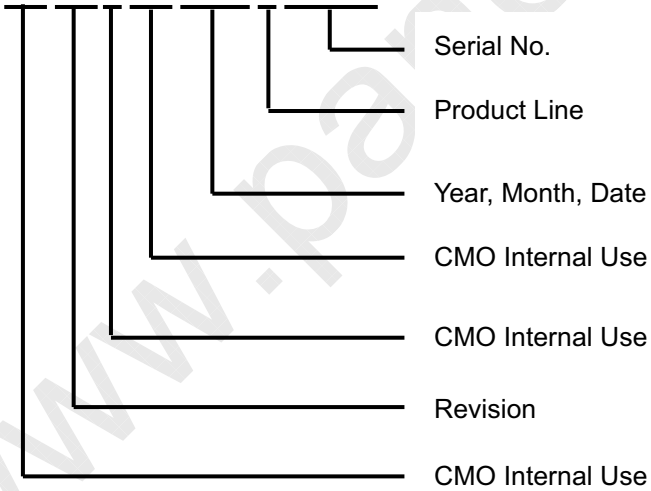
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



Model Name: V460H1-LE3

Revision: Rev. XX, for example: A0, A1… B1, B2… or C1, C2…etc.

Serial ID: X X X X X X Y M D L N N N N



Serial ID includes the information as below:

Manufactured Date:

Year: 2001=1,2002=2,2003=3,2004=4…2010=0,2011=1,2012=2..

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I ,O, and U.

Revision Code: Cover all the change

Serial No.: Manufacturing sequence of product

Product Line: 1 -> Line1, 2 -> Line 2, …etc.

10. PACKAGING

10.1 packing specifications

(1) 5 LCD TV modules / 1 Box

(2) Box dimensions : 1175(L)x282(W)x725(H)mm

(3) Weight : approximately 56 Kg (5 modules per box)

10.2 packing METHOD

Figures 10-1 and 10-2 are the packing method

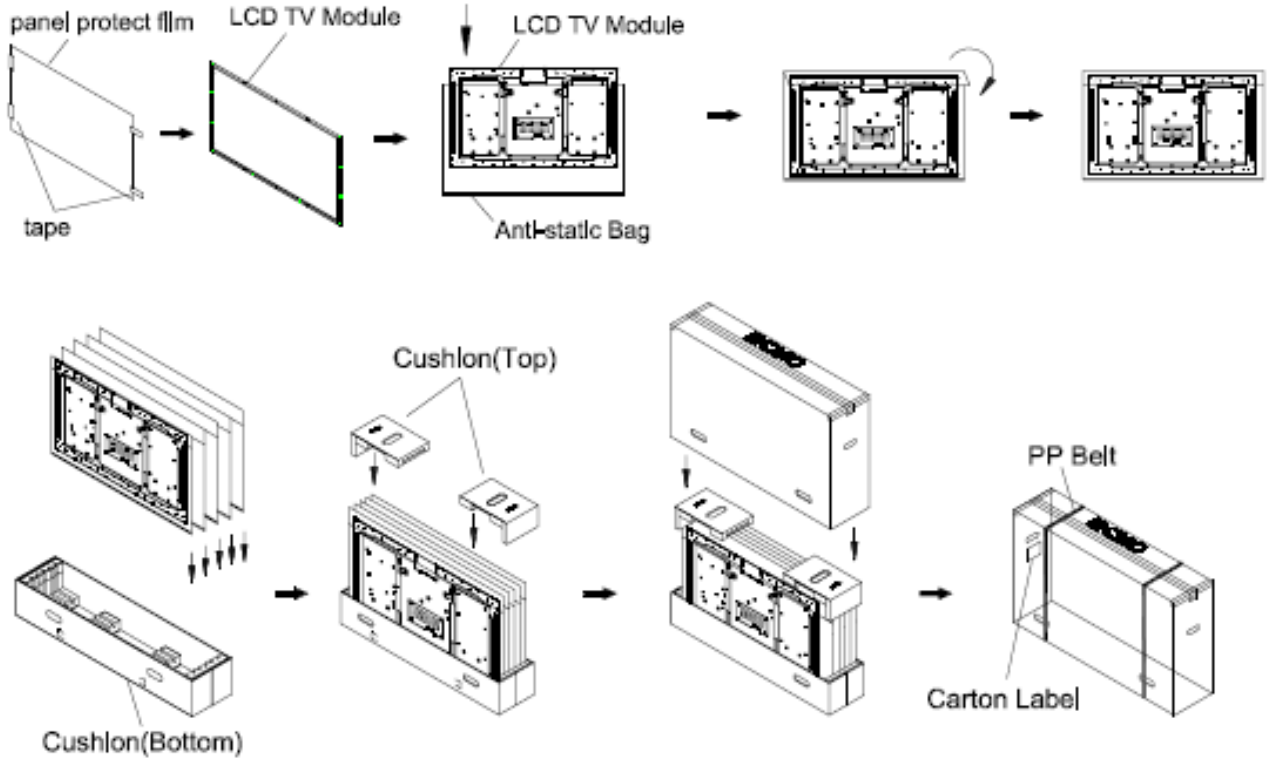


Figure.10-1 packing method

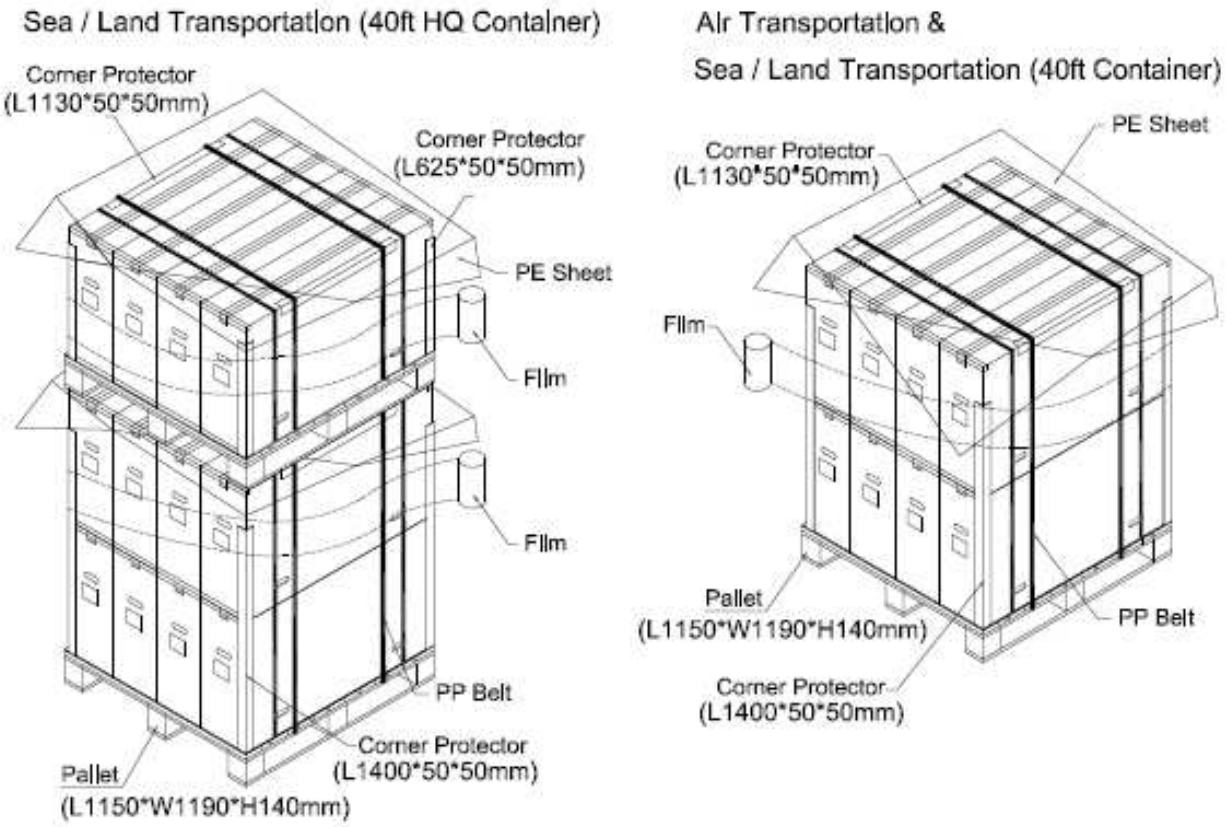


Figure.10-2 packing method

11. MECHANICAL CHARACTERISTICS